

## **Group 1: Definitions and Classifications**

**Q1:** What were the differences between the 2017 US paediatric guidelines and the 2016 European Society of Hypertension (ESH) guidelines in terms of blood pressure cut-points for adolescents?

**Groundtruth:** The 2017 US paediatric guidelines recommended using US adult cut-points ( $\geq 130/80$  mm Hg) for adolescents starting at age 13, while the 2016 ESH guidelines recommended European adult cut-points ( $\geq 140/90$  mmHg) for adolescents starting at age 16, which is more consistent with physiological body growth.

**Q2:** Define Hypertension in Children and adolescents?

**Groundtruth:** Hypertension in children and adolescents is defined statistically due to the lack of direct cardiovascular outcome-based thresholds. According to the **ESC Consensus**, hypertension is diagnosed in children under **16 years** when blood pressure is at or above the **95th percentile** for sex, age, and height. From **16 years onward**, the adult threshold of  **$\geq 140/90$  mmHg** applies. This differs from the **AAP (2017)**, which sets  **$\geq 130/80$  mmHg from age 13**, and the **ESH (2016)**, which retains NHBPEP nomograms including overweight and obese children. The **ESC Consensus supports using modified AAP tables up to age 16 while calling for European normative standards**.

**Q3:** What is the rationale of using the 95th percentile as a threshold in pediatric hypertension diagnosis?

**Groundtruth:** The **95th percentile threshold** for diagnosing pediatric hypertension, as endorsed by the **ESC Consensus**, is a **statistical definition** reflecting the distribution of blood pressure in healthy children of the same sex, age, and height. Since long-term cardiovascular outcome studies in children are not feasible, hypertension in this population is identified based on deviation from normal BP ranges rather than absolute risk thresholds. The 95th percentile ensures that only children with blood pressure levels significantly above the expected physiological range are classified as hypertensive, helping to reduce **false-positive diagnoses** due to normal growth-related variations.

**Q4:** Why does the American Academy of Pediatrics (AAP) exclude overweight/obese individuals from normative BP tables?

**Groundtruth:** The American Academy of Pediatrics (AAP, 2017) excludes **overweight and obese children** from normative blood pressure tables. This methodological change results in **lower percentile values** for normal-weight children, which in turn **increases the prevalence of diagnosed hypertension** compared to earlier definitions. The rationale behind this approach is that including **overweight and obese** children in normative tables raises BP reference values, potentially leading to **under diagnosis** of hypertension in this group.

## **Group 2: Evaluates Technical Proficiency in Blood Pressure Measurement Techniques**

**Q1:** What is the correct positioning for a child during office blood pressure measurement?

**Groundtruth:** The child should be **seated in a quiet environment**, with their **back fully supported** and **feet flat on the floor**. If the feet do not reach the floor, they should be placed on a stable surface. The **measuring arm must be fully supported at heart level**, with the **palm facing upward** to ensure accurate readings.

**Q2:** How many office blood pressure measurements are recommended during a single visit, and how should they be averaged?

**Groundtruth:** It is recommended to take three blood pressure measurements, 1-2 minutes apart, during a single visit. The first measurement should be discarded, and the average of the last two measurements should be used.

**Q3: What is the importance of using validated blood pressure measurement devices in children?**

**Groundtruth:** Using **validated blood pressure measurement devices** is essential to ensure **accurate and reliable readings** in children. Only devices that have been **specifically validated for pediatric use** should be used, as non-validated devices can lead to **measurement errors, misclassification of blood pressure, and incorrect hypertension diagnosis or management.**

**Q4: What are the recommended intervals for blood pressure measurements during 24h ambulatory blood pressure monitoring (ABPM)?**

**Groundtruth:** During **ambulatory blood pressure monitoring (ABPM)**, blood pressure measurements should be scheduled **at least every 20 minutes during the daytime** and **at least every 30 minutes during the nighttime** to ensure a reliable 24-hour blood pressure profile.

### **Group 3: Tests understanding of diagnostic workflows and secondary causes**

**Q1: What is the initial step in diagnosing hypertension in children and adolescents?**

**Groundtruth:** The initial step in diagnosing hypertension in children and adolescents is **office blood pressure (OBP) measurement** using a validated device and an appropriately sized cuff. **At least three BP measurements** should be taken, **1-2 minutes apart**, with the **average of the last two readings** used for evaluation. **Blood pressure should be measured in both arms and one leg at least once** to screen for **aortic coarctation**, especially in younger children or if an arm-leg BP discrepancy is suspected.

**Q2: What is the role of 24h ambulatory blood pressure monitoring (ABPM) used in the diagnosis of hypertension in children?**

**Groundtruth:** 24-hour ambulatory blood pressure monitoring (ABPM) plays a critical role in the diagnosis and management of hypertension in children and adolescents. It is particularly useful for confirming hypertension in cases of suspected white-coat hypertension, masked hypertension, and secondary hypertension. ABPM is also recommended for children with diabetes, chronic kidney disease (CKD), and those requiring monitoring of antihypertensive therapy. It provides a comprehensive 24-hour BP profile, assessing daytime and nighttime BP patterns, nocturnal dipping, and BP variability. Due to the complexity of interpretation, ABPM should be conducted and analyzed in centers with expertise in pediatric hypertension to ensure accurate diagnosis and appropriate clinical decision-making.

**Q3: What are common secondary causes of hypertension in children?**

**Groundtruth:** The most common **secondary causes of hypertension in children** are **renal parenchymal diseases** (e.g., glomerulonephritis, reflux nephropathy, chronic kidney disease) and **renal vascular diseases** (e.g., renal artery stenosis, fibromuscular dysplasia). **Cardiac causes** include **aortic coarctation**, which should be ruled out by measuring BP in both arms and one leg. **Endocrine causes** include **primary hyperaldosteronism, congenital adrenal hyperplasia (CAH), pheochromocytoma, Cushing syndrome, and hyperthyroidism**. Other less common causes include **neurologic disorders** (e.g., increased intracranial pressure), **genetic syndromes** (e.g., monogenic hypertension), and **medication-induced hypertension** (e.g., steroids, sympathomimetics, oral contraceptives).

**Q4: What laboratory tests are recommended to evaluate secondary hypertension in children?**

**Groundtruth:** The evaluation of secondary hypertension in children includes laboratory and imaging tests to assess renal, endocrine, and metabolic causes. Renal function is evaluated with serum creatinine, estimated glomerular filtration rate (eGFR), sodium, potassium, and bicarbonate levels. Urinalysis is performed to screen for proteinuria and hematuria. Endocrine assessment includes the aldosterone-to-renin ratio for hyperaldosteronism, plasma or 24-hour urinary metanephrines and normetanephrines for pheochromocytoma, and thyroid function tests with TSH and free T4/T3.

**Group 4:** Focuses on treatment decisions and pharmacological strategies.

**Q1: When should pharmacological therapy be initiated in hypertensive children?**

**Groundtruth:** Pharmacological therapy should be initiated in children and adolescents with hypertension in the presence of hypertension-mediated organ damage (HMOD), symptomatic hypertension, stage 2 hypertension, or when hypertension persists despite lifestyle modifications. It is also indicated in children with concomitant conditions such as chronic kidney disease (CKD), diabetes mellitus, or high cardiovascular risk.

**Q2: What are the recommended first-line antihypertensive agents for children?**

**Groundtruth:** The recommended first-line antihypertensive agents for children include angiotensin-converting enzyme inhibitors (ACEi), angiotensin receptor blockers (ARB), dihydropyridine calcium channel blockers (CCB), and diuretics. Beta-adrenergic blockers are generally not recommended except in specific conditions due to potential side effects.

**Q3: How should resistant hypertension be managed in children?**

**Groundtruth:** Resistant hypertension in children requires a **thorough evaluation of medication adherence and screening for secondary hypertension**. If blood pressure remains uncontrolled despite appropriate therapy, referral for **specialized hypertensive diagnostics and management** is necessary. In cases of **acute severe hypertension, urgent intervention** is required to exclude a **hypertensive emergency**. **In hypertensive emergencies, admission to a pediatric intensive care unit is mandatory**, with priority given to **intravenous antihypertensive agents**, such as **labetalol, nicardipine, or sodium nitroprusside**.

**Q4: What is the stepped-care approach for managing hypertension in children?**

**Groundtruth:** The **stepped-care approach** for managing hypertension in children follows a structured escalation strategy:

1. **Step 1: Lifestyle modifications** are the first-line intervention, including dietary changes, increased physical activity, and weight management.
2. **Step 2:** If blood pressure remains uncontrolled, initiate **low-dose monotherapy** with one of the recommended first-line antihypertensive agents (**ACE inhibitors, ARBs, dihydropyridine calcium channel blockers, or diuretics**). If side effects occur, switch to a different drug class.
3. **Step 3:** If monotherapy is insufficient, either **increase the dose of the initial drug to full dose** or **add a second drug at a low dose** (both options are equivalent in the guideline).
4. **Step 4:** If blood pressure remains uncontrolled, escalate to **full-dose combination therapy**.

Potential cases of secondary hypertension must be identified and secondary organ damage must be monitored.

## **Group 5: Broader Impacts and Integration of Management Strategies**

### **Q1: How do lifestyle modifications contribute to the management of hypertension in children?**

**Groundtruth:** Lifestyle modifications, such as dietary adjustments, increased physical activity, weight management, and reducing salt intake, are the first-line strategies for managing hypertension in children. These changes can help lower blood pressure and improve overall cardiovascular health.

### **Q2: What role do parents and family play in the management of hypertension in children?**

**Groundtruth:** Parents and family play a crucial role in supporting and promoting healthy lifestyle changes. Their involvement can help ensure adherence to dietary recommendations, physical activity routines, and other lifestyle modifications, which are essential for effective hypertension management.

### **Q3: Why is it important to consider comorbidities and concomitant risk factors in the management of pediatric hypertension?**

**Groundtruth:** Considering comorbidities and concomitant risk factors is essential in the management of pediatric hypertension, as they can contribute to hypertension progression, hypertension-mediated organ damage (HMOD), and long-term cardiovascular risk. The ESC Consensus (2022) emphasizes that cardiometabolic risk factors (CMRFs) are highly prevalent in children with hypertension and significantly impact long-term cardiovascular health. Addressing these risk factors through lifestyle interventions and, in selected cases, pharmacological treatment is necessary to prevent the progression to atherosclerosis and metabolic syndrome in adulthood.

### **Q4: How can healthcare professionals ensure the successful implementation of hypertension management guidelines in clinical practice?**

**Groundtruth:** Healthcare professionals can support hypertension guideline implementation by following standardized screening protocols, engaging with scientific societies, and participating in professional education. The **ESC Consensus (2022)** emphasizes that implementation requires **multi-level engagement**, where **international societies** educate clinicians and monitor adherence, **national organizations** provide training and integrate hypertension management into public health programs, and **public health agencies** lead awareness campaigns and screening initiatives. This structured approach ensures effective detection, treatment adherence, and improved long-term outcomes.